

DEVONIAN SHALES GAS

Volume 1, Issue 1 October 1977

Eastern Gas Shales Symposium—October 17, 18, 19

*Coordinated efforts to develop an
unconventional source of energy*

The cooperative efforts of over 40 organizations from 15 states to exchange information are starting to impact EGSP tasks. New knowledge is being assimilated into improved techniques for shale gas production. Many of the techniques are now being tested and demonstrated. The progress highlighted at this Symposium represents vigorous, innovative research and cooperative development activities.

The cooperation and active participation of all attendees at the Symposium to identify productive and nonproductive tasks, to evaluate tangents that surface, and to keep practical end goals in mind at all times is extremely important. The feasibility of techniques and devices is being examined from several directions simultaneously. The sooner that new methods are developed and demonstrated, the sooner we will improve well productivity and can work on economic feasibility.

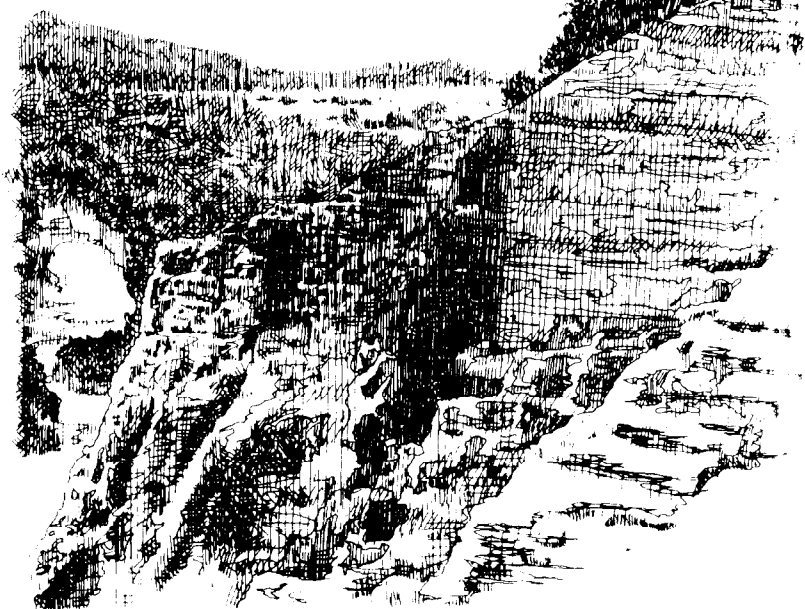
The Eastern Gas Shales Project functions to integrate the planning and research, facilitate the interchange of ideas and information, and focus activities toward the transfer of technology, implementation and commercialization. Little good will come from separate and isolated research. All data evolving are at present being evaluated and integrated to learn about the gas producing potential of the Devonian Shale.

The Open Forum, scheduled from 2 to 4 on Monday, October 17 will have a number of exhibits, displays and slide presentations. Here you'll have an opportunity to discuss the more general problems that are being addressed by the Project as a whole . . . the chronic problem of proving that the Eastern Shales are a commercial and viable resource and the acceleration of commercial-scale projects. The following two days will be full ones and concurrent afternoon sessions require that you select carefully those papers that you would like to hear and debate.

Eastern Gas Shales Project Newsletter

UGR

Open File # 021



William K. Overbey, Jr., Project Manager, EGSP

*The Eastern Gas Shales Project's
greatest natural resource*

A smile spreads slowly over his face as he holds up a picture he has just sketched with a few quick lines. And the story he is ready to recount or the comment that he is about to make will precisely answer the question that has just been raised.

What could be better than a project manager who can illustrate answers to your questions with a quick sketch or an appropriate anecdote? The answer is the one who's been asking the right questions for the past ten years.

Bill Overbey has been dealing with some aspect of the basic project objectives on and off ever since he first started asking himself and others questions about the effect of natural fractures on oil and gas production, and secondary recovery operations.

It all began when he started wondering why the water from water injection operations traveled in a straight line to the producing well. Orientation fractures were obviously a key so oriented cores were taken to determine the direction of the fractures. Ultimately they lined wells parallel to the fractures to alleviate the early, water breakthrough problem.

This experience of how to deal with "losing the front" in the secondary recovery operations coupled with the idea that fractures were one of the main mechanisms for gas to the wellbore, started Bill postulating questions about drilling deviated wells to intercept multiple fractures. The thick zones of the Devonian Shales, ranging from 500 to 1000 feet thick, appeared to be the best candidate for this experiment, but it took from 1969 to 1972 before the first deviated well was drilled. And of course, it was not until last year that the EGSP developed from all this.

Overbey (Continued)

A native of West Virginia, Bill received his degree in Geology from West Virginia University in 1959. He first worked for the West Virginia Geological Survey as a Petroleum Geologist evaluating oil and gas operations in new fields. It was at the U.S. Bureau of Mines, however, where he became interested in the potential of the shales and the techniques and effects of fracturing oil reservoirs.



In the past year Bill and his staff have been enthusiastically working with state geological survey teams, national lab groups, and private industry to accumulate data to more precisely characterize the resource of the Devonian Shale gas.

What is exciting about this collection of data is that even at this early stage we are beginning to see 'an outline of the elephant and can distinguish the tail from the trunk.' Putting together the bits and pieces of information systematically is one of the most important achievements of the project

The EGSP project team has already found in the areas that have been investigated that natural gas is found in the full column of the Upper Devonian Shale, and not just in the rich black shales. The increase in potential that comes from adding the gray shales to the future target areas depends, however, a great deal upon the improvements in stimulation technology since the higher tensile strength of the gray shales makes them harder to fracture than the black shale. On the other hand, the difference in stress levels can be used in the near-term to predict where the higher concentrations of fractures are by modeling the states of stress that can be propagated more easily through the gray shale.

The evolution of new exploration techniques and the results of field tests measuring the feasibility of stimulation techniques are all very promising, although not yet statistically significant, of course. However, realistically, I am confident that in 3 to 4 years we will have the shale in Appalachia characterized well enough that the producers will know not only where to drill but also the expected payoff.

The EGSP project developed from a questioning vision, the results are being measured by a large number of interested and involved people, and the future is being structured by an articulate, knowledgeable, and dedicated Project Manager. We expect the results to be the best and most efficient use of gas from the Eastern Gas-Bearing Shales.

Newsletter Objectives

To provide current and regular information about EGSP for all participants and other interested people

As technical progress occurs in EGSP, overall plans are being reviewed to assure coverage and documentation of these events. Films, brochures, and newsletters are part of this step and are aimed at providing information to a wider audience so they can follow the development and achievements of all phases of the Project. This newsletter is one aspect of an integrated plan designed by SAI to communicate to all personnel involved in the Project and to stimulate the interest of others in supporting EGSP activities.

As the July 1977 USGS monthly report for EGSP puts it:

Communications between cooperators in EGSP are improving; however, we are as yet in need of a quick way to reach members of industry to keep them informed of work going on in the EGSP. Last month's work shops were good but they did not reach a large segment of the people who should be aware of the EGSP.

To satisfy part of the overall information dissemination goals of EGSP the information provided by a regular and timely newsletter will show what is being done, how dollars invested are being spent, and why the inevitable traceoffs are occurring. It permits ongoing awareness and evaluation of activities of interest and will provide an integrated view of activities of immediate concern as well as of ultimate historical significance.

An opportunity to look at the whole EGSP picture and to know who to ask about some of the elusive elements helps prevent any of us from becoming isolated and nourishes a unity in direction and ultimate goal achievement.

We welcome your response to and comments about the newsletter. Improvement in details and specifics will come from open communication among us all. We encourage new and innovative ideas for improving technology and would like you to share any insights that you have gained since working on the Project.

Devonian Shale Gas Newsletter edited and published for the Eastern Gas Shales Project by Science Applications, Inc. and sponsored by the Morgantown Energy Research Center.

Editor Constance Putnam
Art Director Frank Varcolik
Technical Advisor William McGlade

Please send all contributions, comments and articles of special interest to the editor:

8400 Westpark Drive
McLean, Virginia 22101
(703) 821-4339

Eastern Gas Shales Project—The First Year

How the EGSP is dealing with a historically marginal reserve

During this first year the Project has focused on the development and testing of feasible ideas to solve the problems that are unique to gas shale production. Initially, EGSP is taking an inventory and characterizing the gas-bearing shale of interest, determining how to locate concentrations of gas and fractures with certainty, and working on techniques to improve production and increase the flow rate. The ultimate objective is to accelerate field testing and transfer technology as quickly as possible.

The major strengths come to the project from the expertise, knowledge, and available information of the EGSP contractors and other groups that are familiar with the Appalachian, Illinois, and Michigan Basins. Other important research activities of a generic nature are pursued by contractors throughout the nation. The EGSP participants are cooperating to achieve project goals and are covering a lot of ground to develop the commercial potential of the gas in place. One critical problem that continues to limit the achievement of these goals is the scarcity of production records and data from old wells. These records could be a significant addition to the building of a useful data base.

The success of the Project can be measured by the increase in the number of wells that are being drilled through the shale and by the large number of people becoming interested and involved. The EGSP is attacking the unique problems that are characteristics of the tight shale formations and is modifying applicable devices and techniques to cope with specific needs of natural gas production. Field tests of some of the techniques are showing promise—it appears that cleanup time for wells stimulated with foam is only about 2 to 3 months, whereas hydrofractured wells not using foam required up to one year before they were cleaned up and production had stabilized.

Oriented core work shows that the more productive zones have several sets of natural fractures and that the less productive have only a single set of fractures. The more cores that are made available for testing, the better and more predictable is the selection of commercial gas-producing sites.

Project management staff are receptive to and encourage new ideas. Bill Overbey and his staff look at any new ideas for project tasks and unsolicited proposals that are sent their way. They are particularly eager to receive techniques dealing with dual completions, directional drilling, new fracturing techniques, and exploration techniques.

DOE/MERC/EGSP ROSTER:		(304) 599-extension	
Resource Characterization		Technology Assessment	
Arlen E. Hunt	7265	Charles A. Komar	7107
Asst. Mgr. EGSP		Asst. Mgr. EGSP	
Claude S. Dean	7211	Charles W. Byrer	7547
John J. Kozach	7282	Karl H. Frohne	7412
Clyde Pierce	7100	Albert B. Yost	7325
Washington Liaison:			
Jeff Smith		376-4806	

Sounding Board

Q. John Avila of Ashland Oil Company, one of the panel members at the Lexington, Kentucky information exchange meetings, expressed his optimism that shale gas is one of the most promising alternate sources of energy for the immediate future. This promise, however, is dependent upon advances being made in well completion techniques. He questioned the emphasis being put on fracturing.

It may be that the main source of migration of gas in the shale is along bedding planes, thus fracturing may be over-emphasized.

A. Bill Overbey notes that the importance of bedding planes is apt to be valid in Kentucky, but probably not in most other areas. EGSP petrographic studies show that the silt layers are usually discontinuous so their use as flow channels may be limited.

We are finding that through EGSP we can see all the trees in the forest. It's a distinct advantage to all of us to be able to have evidence and enough facts and data to distinguish between isolated incidences and universal characteristics.

This sort of question again points up the need for accumulating as much information about production and drilling as possible. Historical logs, notes, and other production records will provide backup data for the study.

Q. Ben R. Oates works for Reynolds & Vincent, Inc., a small independent production company operating in the Illinois Basin. He attended the meeting in Lexington and responded with a long and penetrating letter about EGSP and the efficiencies and economics of drilling shale wells. One of the questions he raised deals with the practical problem of developing techniques that can be used to evaluate the gas potential as the well is being drilled.

Once a test hole is drilled, we do not know how to evaluate the producing capabilities short of completion of the hole.

A. Arlen Hunt, Assistant Project Manager of the EGSP, acknowledges that this is a problem that is receiving considerable attention from EGSP contractors. In the shale inventory and characterization portion of the Project, Eastern Shale cores are needed for testing to determine properties of the rock. Information that is gathered is being banked in the computer and will be correlated with new exploration techniques to determine where drilling for gas might be more effective.

One of the most encouraging techniques comes from using aerial photography and LANDSAT satellite imagery. The lineaments indicative of possible fracture zones deep in the shale formation are revealed and can be mapped.

The actual prediction of producing capabilities prior to completion, however, will have to be based on more complete information of shale intervals throughout the region.

EGSP Project Activities and Accomplishments

EGSP tasks are testing feasibility, usability, and applicability

Many of the Project accomplishments to date come from lab groups that are characterizing the resource and from field activities that are testing stimulation techniques. Core samples are being analyzed, outcrops are being examined, well logs and production records are being correlated with field observations, maps are being generated, and designs are being tested and modified to locate and stimulate wells. Economic analyses and assessments of environmental impacts are parts of the demonstration phase of the Project.

Contractors have prepared preliminary versions of the following maps:

- Structure contour map on top and base of the New Albany Shale in the Illinois and Michigan Basins
- Structure contour maps of the Dunkard and Rhinestreet Shales in Pennsylvania
- Isopach and structure contour maps of the Huron Shale
- Isopach maps of the radioactive facies of the Lower Huron Member and Rhinestreet equivalents in Ohio
- Basement structure maps for eastern Kentucky and West Virginia
- Structure contour maps on the Big Lane and Berea Sand Formations in West Virginia
- Gas field map for Devonian Shale wells in Kentucky and West Virginia

The Henderson County, IL, well was cored on July 1977. A total of 57 samples from the 300 foot cored interval were cased for analysis. Liaison between DOE, and the Northern Illinois Gas Company was conducted by the Illinois Geological Survey. The West Virginia Geological Survey supervised field collection of the core.

Mound Laboratory reports that the first full set of shale dilatometry samples has been tested and that testing of a second set has begun.

The University of Southern California has developed a calibrated infrared method for direct determination of the pyrite concentration of kerogen.

Core samples for offgas analysis were collected from Henderson and Tazewell Counties, IL by Battelle Columbus Laboratory.

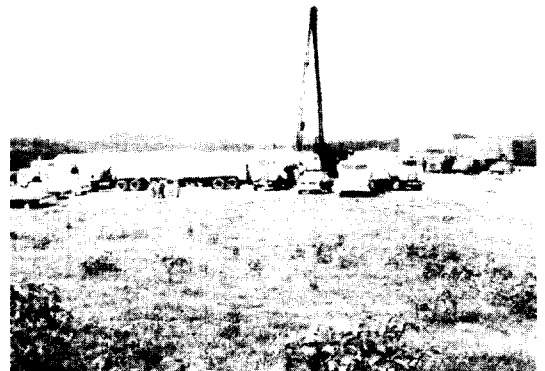
Lawrence Livermore Laboratory has prepared a regional EIA to cover the 21 potential well sites selected for AMEX/VESCORP's contract.

Preliminary draft report of the Environmental Impact Assessment on the proposed Consolidated Gas, Inc. deviated well in West Virginia was completed by Lawrence Livermore Laboratory. This report states that no serious environmental problems are anticipated.

Columbia Gas Systems conducted two MHF treatments in Wells 20401 and 20403 in Lincoln County, WV. Well 20401, Zone 1 production was raised to 110 Mcfd and Zone 3 (Middle Gray Shale) was treated with a modified MHF of foam and water. A reservoir test of Zone 3 of Well 20403 was completed and Zone 4 (Upper Gray Shale) treated with a foam MHF.

On September 13, 1977 Columbia stimulated Well No. 20338 located in Wise County, VA with a cryogenic tracer. The fluid injection rate established was 30.2 B.P.M at 1910 psi.

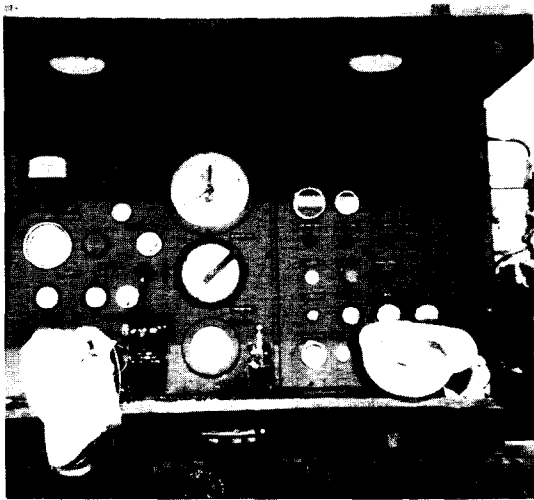
SAI submitted a final draft report of the Environmental Impact Assessment (EIA) for the MERC-1 well to the Morgantown Energy Research Center. This DOE sponsored well is to be spudded this fall on the grounds of the MERC facility. The EIA document provided a detailed assessment of the anticipated impacts of the well on the environment and recommended attenuation plans for the significant impacts.



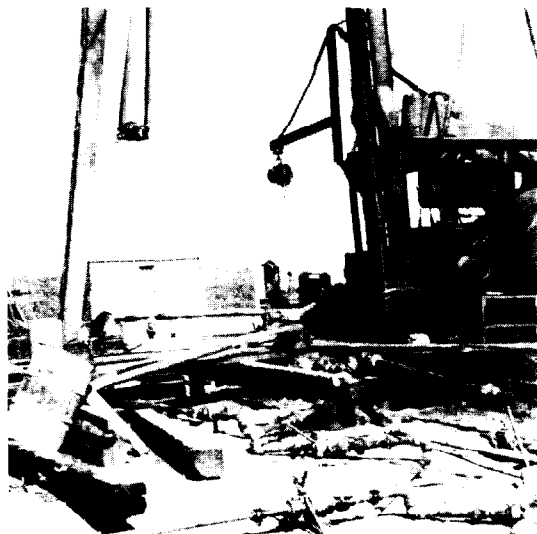
View of Lincoln County, WV, site where Columbia Gas treated well with a modified MHF of foam and water



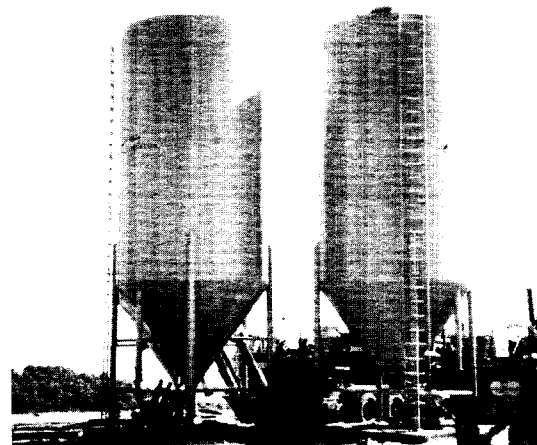
Radioactive Beads poured into blender during MHF Treatment in Lincoln County, WV.



N₂ pump control panel



Wellhead connection at Well No. 20403



Sand Storage Silos

The Illinois Geological Survey MINERS data management system now has the following capabilities:

- To draw maps of the whole state or any part of the state at any scale
- To plot geographic distribution of joints, such as drillholes and outcrops
- To plot data lines, contours, and trend surfaces.

University of Kentucky has prepared a tentative correlation table for cross sections between Ohio, Kentucky, West Virginia, and Virginia.

WVU's shale physical characterization results correlate well with other researchers and indicate a relationship exists between directional sonic velocity, tensile strength, and fracture orientation in Devonian Shale samples.

SAI prepared a map standardization format to be used for all EGSP maps and has distributed it to all contractors.

The Illinois Geological Survey has completed construction of 17 stratigraphic cross sections from geophysical logs and a generalized preliminary isopach map of the entire New Albany Group for the State of Illinois.

The Pennsylvania Geological Survey production and show map was sent to ERDA MERC for final approval and publication.

WVGS created and stored on tape a file of producing Devonian Shale wells in West Virginia.

WVU constructed a map of the Mount Alto (Cottageville, WV) Field. Some 225 wells have been located on the map and production histories for 80 percent of the producing wells have been compiled.

WVGS has generated preliminary structural contour maps on the top of the Berea Sandstone and Onondaga Limestone, and completed a Devonian Shale penetration map for Jackson County, WV.

The New York Geological Survey has assembled the basic data for the preliminary gamma ray stratigraphic correlation work.

The West Virginia Geological Survey has designed a coding form for entering stratigraphic data from drillers logs and has coded data from Cabell and Wayne Counties, WV.

AMEX/VESCORP completed the title surveys and legal requirements for four well locations in Lawrence and Scioto Counties, OH. An archeological assessment was also completed.

The Indiana Geological Survey determined porosities on 70 samples and acoustical data on 18 samples of the Phegley core, Sullivan County, IN. Porosities, in general, were less than 1 percent.

Battelle Columbus Laboratory determined that there is a general inverse relationship between initial gas content and bulk density of the shale sample. There does not, however, seem to be a simple relationship between porosity and bulk density.

The University of Kentucky has completed adsorption-desorption studies of 37 shale samples.

USGS staff examined Devonian Shale outcrops along the Cincinnati Arch and collected joint/lineation data in the Valley and Ridge of Virginia and West Virginia.

West Virginia University reports that 75 percent of the area of the eastern Kentucky project, which proposes to establish the regional fracture patterns found in shales, coals, and limestones, has been sampled on a one station per quadrangle grid.

A contract modification is being submitted to Petroleum Technology Corporation which will extend the completion date of the three contracts, accelerate the overall program, stimulate two wells simultaneously, and replace two dual stage stimulations with two single stage stimulations.

Tulsa Conference

The feasibility of getting gas from Devonian Gas Shales is improving

Optimism was the keynote of reports about the Eastern Gas Shales Project that were presented at the 3rd Annual Symposium on Enhanced Oil, Gas Recovery and Improved Drilling Methods held in Tulsa last month. Highlighted was success in massive hydraulic fracturing to boost production flow rates and in remote sensing techniques for picking the best well sites.

Midway through a multi-MHF experiment in the Big Sandy Field, Lincoln County, West Virginia, Columbia Gas Co. reported that "gas is definitely present in zones of the shale that have never been historically produced before." Other advanced stimulation techniques that are being investigated include dendritic fracturing, cryogenic fracturing, foam fracturing, and chemical explosive fracturing. Remote sensing techniques will be assessed in a field demonstration in Ohio conducted by Amex/Vescorp in a cooperative venture with the Department of Energy, Ohio ERDA, and the National Petroleum Corporation.

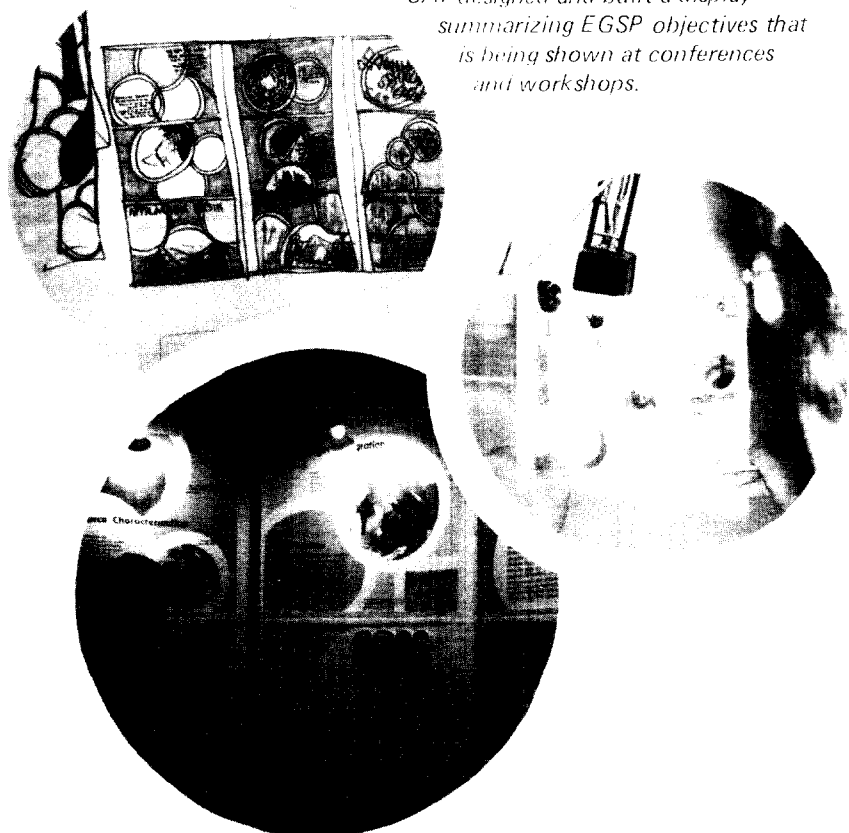
The firms believe that Devonian Shale reserves are greater than those of Devonian Sandstones. However, some pointed questions from the audience made it obvious that a concerted effort is needed to maintain credible reserve predictions in the resource delineation phase of the project. Because the shale produces much more slowly than wells in the sandstone, the economics are dependent upon improving production techniques dealing with natural fracture systems and effective stimulation methods.

Future Issues

Future issues will feature a variety of topics including directional drilling, reclaiming old wells, problems of fracturing out-of-zone, identification of stressed areas as an exploration technique, production data analysis for MHF wells, and fracturing containment analyses.

There is discussion that an Accelerated Eastern Gas Shales Technology Demonstration will be undertaken by DOE. Contractor profiles, PI interviews, and stories of interest will be welcomed.

From original design sketch and 6-inch model to first display at Tulsa took little over a month. SAI designed and built a display summarizing EGSP objectives that is being shown at conferences and workshops.



EGSP Hails a New Master

October 1, 1977. Environmental Research and Development Administration officially became part of the Department of Energy and the Eastern Gas Shales Project in Morgantown, West Virginia is in the process of changing all ERDA's to DOE—among other things.

A Very Usable and Dynamic Film

The DOE film, "The Eastern Gas Shales Project," will be previewed at the Eastern Gas Symposium being held in Morgantown, West Virginia. This 12-minute film was produced for MERC by Stefan Dobert Productions in association with SAI. It will be available for showing at workshops, conferences, and small group meetings that are interested in enhanced gas recovery from the Eastern Shales.

Up and Coming Events

Since exposed rocks weather and dilate, how much does the surface expression of the Devonian outcrop reveal about the Devonian Shale at depth? Opinions vary and even descriptions of the observed characteristics are not systematic or consistent. Positive value is to be gained from having EGSP contractors involved in characterizing the resource meet together at selected outcrop sites, and discuss and postulate about what they see and what they think. Field trips for this purpose will be scheduled from time to time.

Open File Information

The following publications are available from MERC. Plans for additional open files in the future include Reston Va., University of Kentucky, and a Columbus, Ohio location.

Technical Progress Reports (TPR-76/1, 2, 3, 6, 7, 9, 77/2)

- TPR-76/1: *Comparison of Conventional Hydraulic and Water/Nitrogen foam fracturing in two Ohio Devonian Shale gas wells.* (K.H. Frohne, February 1976)
- TPR-76/2: *Lithologic Description of Core Material from Nicholas Combs No. 7239 Well, Perry County, KY.* (MERC)
- TPR-76/3: *Drilling a Directionally Deviated Well to Stimulate Gas Production from a Marginal Reservoir in Southern West Virginia.* (MERC)
- TPR-76/6: *Lithologic Description of Core Material from Glen Gery No. 5-745 Well, Rose Township, Carroll County, Ohio.* (October 1976, MERC)
- TPR-76/7: *Lithologic Description of Cored Wells No. 119 and No. 12041 in the Devonian Shale in the Cottageville, WV, area.* (MERC)
- TPR-76/9: *Lithologic Description of Cored Wells No. 20402 and No. 20403 in the Devonian Shale in Lincoln County, WV.* (MERC)
- TPR-77/2: *Large Scale Foam Fracturing in the Devonian Shale—A Field Demonstration in West Virginia.* (Consolidated Gas Supply Corporation)

Contractor Reports (MERC CR-77/2, 3, 5, 6, 7, 8)

- CR-77/2: *Three Lick Bed: Useful Stratigraphic Marker in the Upper Devonian Shale in Eastern Kentucky and Adjacent Areas of Ohio, West Virginia, and Tennessee.* (January 1977, University of Cincinnati: Linda J. Provo, Roy C. Kepferle, Paul E. Potter)
- CR-77/3: *Fractographic Logging for Determination of Pre-Core and Core-Induced Fractures, Nicholas Combs No. 7239 Well, Hazard KY.* (January 1977, Alfred University: B. R. Kulander, S. L. Dean, C. C. Barton)
- CR-77/5: *Subsurface Stratigraphy and Gas Production of the Devonian Shales in West Virginia.* (March 1977, West Virginia Geological Survey: Douglas G. Patchen)
- CR-77/7: *A Borehole Gravity Survey to Determine Density Variations in the Devonian Shale Sequence of Lincoln County, West Virginia.* (May 1977, MERC: James W. Schmoker)
- CR-77/8: *Geology of Argillaceous Sediments: An Annotated and Illustrated Bibliography.* (June 1977, University of Cincinnati: P. E. Potter, J. B. Maynard, Wayne A. Pryor)

MERC Special Publications (SP-76/2, 77/3)

- SP-76/2: *Devonian Shale Production and Potential: Proceeding of the Seventh Appalachian Petroleum Geology Symposium held in Morgantown, WV, March 1-4, 1976.* (Edited by R. C. Shumaker and W. K. Overbey, Jr.)
- SP-77/3: *Eastern Gas Shales Project: Increasing U.S. Natural Gas Reserves from Eastern Gas-Bearing Shales.* (June 1977, Prepared by Science Applications, Inc.)

Other Publications

- Bibliography of Upper Devonian Shale Sequence.* (Tripplett, January 1976, MERC)
- Increasing Eastern U.S. Natural Gas Reserves from Gas-Bearing Shales.* (November 1976, Paper No. SPE 6364, MERC)
- Devonian-Mississippian Shale Sequence in Ohio.* (Information Circular No. 27, Ohio Geological Survey, Karl Hoover)
- Meeting Notes from Government-Industry Information Exchange from Lexington, Columbus, and Pittsburgh.* (June 20, 22, 24)

EGSP Contractors

Alfred University
New York State College
of Ceramics
Alfred, NY 14802

AMEX-VESECORP
6600 North High Street
Worthington, OH 43085

Battelle Columbus Laboratory
505 King Avenue
Columbus, OH 43201

Chenevert & Associates, Inc.
P.O. Box 2447
Norman, OK 73070

Columbia Gas Systems Service
Corp.
1600 Dublin Road
Columbus, OH 43215

Consolidated Gas Supply Corp.
445 West Main Street
Clarksburg, WV 26301

Environmental Research Institute
of Michigan
P.O. Box 618
Ann Arbor, MI 48107

ERRA (Environmental and Regional
Research Associates)
Geology Department
East Tennessee State University
Johnson City, TN 37601

FMC Corporation, Chemical Group
Headquarters
2000 Market Street
Philadelphia, PA 19103

Illinois State Geological Survey
Room 213, Natural Resource Bldg.
Urbana, IL 61801

Indiana Department of Natural
Resources, Geological Survey
611 North Walnut Grove
Bloomington, IN 47401

JAYCOR
1041 Camino Del Mar
Del Mar, CA 92014

Juniata College
Department of Chemistry
Huntingdon, PA 16652

Lawrence Livermore Laboratory,
University of California
P.O. Box 808
Livermore, CA 94550

Los Alamos Scientific Laboratory
Los Alamos, NM 87545

Mid-State Oil and Gas Co.
217 Hersee Bldg.
Mt. Pleasant, MI 48858

Morgantown Energy Research
Center
Morgantown, WV 26505

Mound Laboratory
Monsanto Research Corporation
Miamisburg, OH 45342

New York State Geological Survey,
NY State Education Bldg.
Room 973
Albany, NY 12224

Principal Investigator

Wayne Brownell
(607) 871-2457

John Ryan (Ext. 5522)
(614) 456-1566

Jack Snyder
(614) 424-7367

Martin E. Chenevert
(405) 364-6377

Robert Forrest
(614) 486-3681

Robert Metzler
(304) 623-3611

Philip Jackson
(313) 994-1200

Kenneth Hasson
(615) 929-4306

John A. Nisco
(215) 299-0090

R. E. Bergstrom
(217) 344-1481

Maurice Biggs
(812) 337-2862

Morris E. Scharff
(714) 453-6580

Paul Schettler
(714) 453-6580

Merle Hanson
(415) 447-1100

William J. Carter
(505) 667-6651

Murell Welch
(517) 773-2953

John Kovach
(304) 599-7282

Ron E. Zielinski
(513) 866-7444

Lawrence Rickard/
Arthur Van Tyne
(518) 474-5818

EGSP Contractors

Ohio Department of Natural
Resources, Division of Geological
Survey
Fountain Square, Building B
Columbus, OH 43224

Orbit Gas Company
711 Leitchfield Road
Owensboro, KY 42301

Pennsylvania Geological Survey
1201 Kossman Building
100 Forbes Avenue
Pittsburgh, PA 15222

Petroleum Technology Corporation
P.O. Box 537
Redmond, WA 98052

Sandia Laboratories
P.O. Box 5800
Albuquerque, NM 87115

Science Applications, Inc.
Chestnut Ridge Professional Bldg.
Morgantown, WV 26505

Stanford Research Institute
Menlo Park, CA 94025

Tennessee Geological Survey
Department of Conservation,
Division of Geology
G-5 State Office Building
Nashville, TN 37219

Tri Star Producing Co., Inc.
Div. of Bio-Petro, Inc.
3180 Adloff Lane, Suite 405
Springfield, IL 62708

TRW Energy Systems Group
7600 Colshire Drive
McLean, VA 22101

United States Geological Survey
Mail Stop 955
National Center Bldg.
Reston, VA 22092

University of Cincinnati
Department of Geology
Cincinnati, OH 45221

University of Kentucky
Department of Geology/
Black Shale Project
Room 232 Bowman Hall
Lexington, KY 40506

University of North Carolina
Department of Geology
Mitchell Hall (029A)
Chapel Hill, NC 27514

University of Southern California
Department of Chemical
Engineering
University Park
Los Angeles, CA 90007

Vanderbilt University
Department of Geology
Nashville, TN 37235

West Virginia Geological Survey
P.O. Box 879
Morgantown, WV 26505

West Virginia University
Department of Geology &
Geography
305 White Hall
Morgantown, WV 26505

Principal Investigator

Richard S. Struble
(614) 466-5344

Donald C. Bensen
(502) 926-1206

William S. Lytle
(412) 565-5030

Sam LaRocca
(206) 885-5200

Carl Schuster
(505) 264-9142

William G. McGlade
(304) 599-9696

D. R. Curran
(415) 326-6200

Anthony Statler
(615) 741-2726

John H. Morgan
(217) 529-0151

Robert Ottinger
(703) 893-2000

Wallace deWitt
(703) 860-6635

J. Barry Maynard
(513) 457-5037

William Dennen
(606) 257-3758

John Dennison
(919) 933-1211

T. F. Yen
(213) 746-2066

Jojak Sumartojo
(615) 322-2420

Larry Woodfork
(304) 292-6331

Robert Shumaker
(304) 293-5603